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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/039,333	11/09/2001	Gene H. Lee	5545 (2616-012)	1508

32588 7590 09/13/2004

APPLIED MATERIALS, INC.
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EXAMINER	
TRAN, BINH X	

ART UNIT	PAPER NUMBER
1765	

DATE MAILED: 09/13/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/039,333	LEE ET AL.	
	Examiner	Art Unit	
	Binh X Tran	1765	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *28 June 2004*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-21* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☒ Claim(s) *19-21* is/are allowed.

6)☒ Claim(s) *1-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

2. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

3. Claims 1-4, 7-8 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumar (EP 0837497 A2) in view of Hasegawa et al. (US 5,556,500).

Kumar discloses a plasma etching a tungsten-containing layer (16) having a patterned hard mask (18) comprising:

placing the substrate in a plasma zone;

introducing into a plasma zone a process gas mix comprising NF_3 and Cl_2 (col. 4 lines 23-28);

forming a plasma from the process gas mix to etch the tungsten-containing layer substantially anisotropically (Fig 1-2, col. 3).

Kumar fails to disclose the tungsten-containing layer is substantially pure tungsten. However, Kumar clearly discloses the tungsten-containing layer is WSi. In a tungsten etching method, Hasegawa teaches that WSi or substantially pure tungsten can be etched using the same etchant gas comprises NF_3 and Cl_2 (col. 9 table 1). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Kumar in view of Hasegawa by using substantially pure tungsten because equivalent and substitution of one for the other would produce an expected result.

Kumar does not explicitly state that the etch rate of tungsten-containing layer is greater than the etch rate of the hard mask. However, Kumar discloses that the etch rate of tungsten-containing layer and polysilicon is about the same (i.e. selectivity 1:1, col. 3 lines 8-10). Kumar also discloses that the polysilicon is etched at a greater rate than hard mask (selectivity 5:1, col. 3 lines 11-14). Base on this information, the examiner interprets that Kumar implicitly discloses the etch rate of tungsten layer is greater (more specific 5 times faster) than the etch rate the hard mask.

Respect to claims 2-3, the examiner interprets that Kumar discloses the tungsten layer is etched at an etch rate about 5 times faster than the hard mask (read on the limitation "at an etch rate at least twice ..." and/or "2.5 greater than..."). Respect to claim 4, Kumar discloses that variation in etch uniformity of 3% or less, etch rate microloading was less than 3% (read on "critical dimension loss of less than 4%") and sidewalls angle close to 90 ° (col. 3 lines 13-17, col. 5 lines 10-15). Respect to claim 7,

Kumar discloses the gas mix consist essentially of NF_3 and Cl_2 (col. 7 lines 20-25). Respect to claim 8, Kumar discloses the process gas mix further comprise a passivator gas (col. 2 line 39-43).

4. Claims 5-6, 9-18 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kumar and Hasegawa as applied to claims 1-4, 7-8 above and further in view of Qian et al. (US 6,136,211).

Claims 5-6 differ from Kumar and Hasegawa by the specific volumetric flow ratio of NF_3:Cl_2. In an etching method, Qian teaches the volumetric flow ratio of NF_3:Cl_2 is a result effective variable (col. 4 lines 20-29). According to Qian the volumetric flow ratio of NF_3, Cl_2 is selected to remove substantially all etchant residues. It would have been obvious to one having ordinary skill in the art, at the time of invention, to select a specific volumetric flow rate ratio of NF_3, Cl_2 because this ratio will determine the amount of residues to be removed as disclosed by Qian.

Respect to claim 9, Kumar fails to disclose that the hard mask layer comprises silicon nitride. However, Kumar discloses the hard mask layer is made of silicon oxide. Qian teaches that the hard mask layer can be either silicon oxide or silicon nitride (col. lines 12-14, col. 8 lines 24-26). It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Kumar and Hasegawa in view of Qian by using silicon nitride hard mask because equivalent and substitution of one for the other would produce an expected result.

Respect to claim 10, Kumar discloses the step of applying the energy to the coils and the electrode to ionize the process gas (Fig 3A). However, Kumar fails to explicitly

disclose applying the RF energy to the inductor coil. Qian discloses the step of applying RF energy (110, 155) to the inductor coil (115) and process electrodes. It would have been obvious to one having ordinary skill in the art, at the time of invention, to modify Kumar and Qian by applying RF energy to inductor coil and process electrodes because it will directly increase plasma density over the substrate. The limitations of claims 11-18 have been discussed above.

Allowable Subject Matter

5. Claims 19-21 are allowed.

6. The following is a statement of reasons for the indication of allowable subject matter: The cited prior arts fail to disclose or suggest the step of the ionizing the over etch process gas mix comprising Ar and Cl_2 to form plasma ions that energetically impinges on substantially pure tungsten layer and hard mask layer by applying RF energy to the inductor coil and process electrode, wherein any remaining portion of substantially pure tungsten that is not masked by the hard mask is substantially anisotropically etched away in conjunction with all other limitations in the claim.

Response to Arguments

7. Applicant's arguments that Kumar fails to disclose a substantially pure tungsten layer with respect to claims 1-18 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

8. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP

§ 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Binh X Tran whose telephone number is (571) 272-1469. The examiner can normally be reached on Monday-Thursday and every other Friday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on (571) 272-1465. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only.

For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Binh X. Tran

NADINE G. NORTON
SUPERVISORY PATENT EXAMINER